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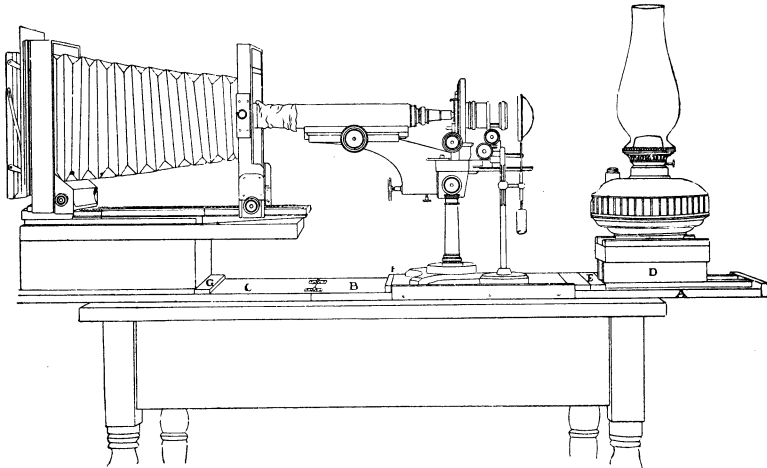
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PHOTOGRAPHING WITH HIGH POWERS BY LAMP-LIGHT.

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Since the introduction of dry plates photomicrography has become comparatively easy, but when looking over the literature of the last few years, and the illustrations of photomicrographic apparatus published in the Journal of the Royal Microscopical Society, in the catalogues of the manufacturers, and in other publications, one may come to the conclusion that it must be an exceedingly complicated and very difficult affair. I will show you, however, that such is by no means the case; that, on the contrary, the procedure is a simple one, and that very few appliances are needed. The whole apparatus used by me in photographing with high powers, *i. e.*, powers over 400 or 500 diameters amplification, consists, as you will see, of a microscope stand, of which the body can be placed in a horizontal position, a well-corrected objective, a Huyghenian eye-piece (any good eye-piece will do), an Abbe condenser (not needed with lower powers), a bull's-eye condenser, a common coal-oil lamp (so-called kitchen lamp) placed on a small table only a few inches high, so as to bring the illuminating portion of the flame into a horizontal line with the center of the microscope tube, a common (amateur) photographic view camera (I use Blair's reversible), a support for the camera, so as to bring its center into a horizontal line with the center of the microscope tube, and a foot-board for the whole apparatus. (See illustration).

This foot-board, which is placed on a table, is divided into three parts, which we may call the anterior, middle, and posterior. It is made of half-inch pine lumber, and therefore very light; it is 10 inches wide, and $42\frac{1}{2}$ inches long, but may be made longer if a camera with very long bellows is used. Its anterior part, which is 11 inches long, has two longitudinal, parallel cleats, between which fits the little table for the lamp. These cleats being parallel to each other and equidistant from the longitudinal center of the board, allow the table to be moved forward and backward, but not sideways. Hence, as the little table has also parallel longi-



Description of Figure. — A, B, and C show the anterior, middle, and posterior divisions of the footboard; D is the movable table for lamp; E, F, and G transverse cleats to prevent undue longitudinal movement of the lamp-table, microscope, and camera support. The parallel longitudinal cleats for each part are also shown in the figure, — these keep all parts of the apparatus in a correct central line.

tudinal cleats, equidistant from its longitudinal central line, on top, between which fits the lamp, the latter can only be moved forward and backward, and must remain above the center of the board. Hence, as its height is invariable, the center of the flame always is on a line with the center of the

microscope tube. The posterior division of the footboard also has two parallel longitudinal cleats, equidistant from the center, and just far enough apart to permit the (wooden and very light) support of the camera to be moved forward and backward between them, but not sideways. This support of the camera is to the latter what the little table is to the lamp, and as it also has two parallel longitudinal cleats on top, between which the camera can be moved forward and backward but not sideways, it must remain in the center. The posterior division of the foot board is 11 inches long, but, if desired, it may be made longer. Both the anterior and posterior divisions are separated from the central division by transverse cleats, which prevent the little table for the lamp from being pushed backward, and the support of the camera from being pushed further forward into the middle division. The latter also is provided with parallel longitudinal cleats, equidistant from the center, and far enough apart to receive the footboard of the microscope between them. They serve to keep the latter in a strictly central position, and do not admit any side movement. From this description and from the apparatus before you, it will be seen that nothing can be moved sideways or out of the central line, but that everything can be slid forward and backward a certain distance with the greatest ease. The only thing that can be moved in every direction, because simply placed on the footboard of the microscope, is the bull's-eye condenser. This is necessary because its position needs changing when oblique light is used, passed through the Abbe condenser, or when the light of the flame of the lamp varies a little. But the bull's-eye is easily adjusted. If it is desirable to use always the same length of camera, and to obtain the same amplification with the same objective and the same eye-piece, a little clamp, such an one as you see on the posterior part of the support of the camera, will prevent the latter from being moved backward, and as the transverse

cleat between the posterior and middle division of the footboard prevents the support from being moved forward on to the middle division, the camera can always be placed in exactly the same position. The microscope clamped to its own footboard, may be moved backward, but cannot be moved forward on account of the transverse cleat, separating the anterior part of the footboard carrying the lamp, from the middle division, holding the microscope. Consequently the distance between the object on the stage to be photographed and the dry plate in the plate holder of the camera, as also the length of the camera, will invariably be the same, if the microscope and its footboard and the support for the camera are placed as far forward, and the camera as far backward as possible. If a lower amplification is wanted, either the microscope may be moved backward, or the camera may be pushed further forward, and if it is desired to increase the amplification the support for the camera may be moved backward, or the small clamps must not be used, and the camera may be slid backward. In this way the distance between the object and the dry plate may be decreased, or be increased, as desired.

The connection between the microscope tube and the eye-piece on the one hand and the camera on the other, is very simple and perfectly light-tight. A wooden tube, made of a pill-box by cutting a round hole in the bottom, blackened on the inside, and fitting over the eye-piece and the tube of the microscope, is fastened (glued) to the base-board of the camera, and to make the connection so as to exclude all possible extraneous rays of light I glued a piece of velvet around the wooden tube. This piece of velvet projects a few inches, and forms a tube which fits loosely over the tube of the microscope.

I will not say anything about the advantage of using an eye-piece in photomicrography, except that my apparatus as you see it before you, enables me to easily reach the fine

adjustment of the microscope, and also the milled heads of the mechanical stage with my right hand while focusing on the ground-glass screen of the camera, which would not be possible without using an eye-piece. The other advantages have been so ably explained by the Hon. J. D. Cox a few years ago, that I do not need to state them. Moreover, my photographs and transparencies, which Prof. B. F. Thomas will have the kindness to exhibit with his electric lantern, may speak for themselves, and will show, not only what can be done by lamplight, and with American objectives—the one used in making the photographs is a Spencer $\frac{1}{10}$ homogeneous immersion, N. A. 1.38—but also what may be accomplished by photographing with a common Huyghenian eye-piece. For *Amphipleura*, a No. 2, giving a supra-amplification of 8.2 diameters, and for the bacteria a No. 1 eye-piece, giving a supra-amplification of 4.909 diameters have been used.

I will now show you how I make a photomicrograph. I first set up my microscope as for common work, the microscope of course inclined, notwithstanding that I use cedar oil as immersion fluid, for I do not like to place myself in an uncomfortable position by making a cat's back to look from above into a perpendicular tube. There is no danger that my cedar oil will run, for, as you see, I only use a minimum quantity. Now, having found and focused my object, I remove the mirror, put the body of the microscope in a horizontal position, and place the instrument, clamped to its footboard, in its place between the cleats of the central division of the photomicrographic footboard as far forward as I can. I now put the lamp on its table between the cleats of the anterior division, the edge of the flame of the flat wick towards the microscope, and so that a longitudinal line drawn through the flame corresponds to the central longitudinal line of the whole apparatus. This done I put the bull's-eye condenser in its proper place, move the lamp and bull's eye forward or backward, so as to get the best possible light and a uniform

illumination of my object. This arranged I focus again, and the focus being all right I put the camera and its support from backward forward in its place between the longitudinal cleats of the posterior divisions of the footboard. This done, I move the anterior part of the camera forward by means of the rack and pinion until camera and microscope are connected, which, as you see, is easy, because the support of the camera is of such a height that the nose (the wooden tube fastened to the lens-board) of the camera, and tube of the microscope have the same center; lateral movements, as already stated, being excluded by my footboard. Having made the connection and adjusted the tube of velvet around the microscope tube, I focus again through the ground glass of the camera, which, too, is easy, because, as you see, I can without any difficulty reach the fine adjustment while focusing. Knowing that ground glass is too coarse for a fine focus with a high power, I have fastened with a little balsam a thin $\frac{6}{8}$ inch cover to the ground surface of the ground glass, and if desiring to make the focus very accurate I use an eye-piece (preferably a No. 1) as a focusing glass. If you will now take a look at my focus you will see the image of my object—the bacilli of swine plague—if not so plainly, at least as accurately on that cover glass as you would be able to see it through the tube of the microscope. As the objective I have on—an apochromatic $\frac{1}{12}$ inch homogeneous immersion objective, N. A. 1.35, of E. Leitz in Wetzlar—is a well-corrected lens, I do not need to change my focus in the least, but can insert my plate. In $2\frac{3}{4}$ minutes I can remove it.

NOTE.—The object in this case was *Bacillus suis*, Detmers: the amplification given by the apparatus used—the eye-piece a No. 1 Huyghenian, and the objective, as stated, a $\frac{1}{12}$ inch—was about 800 diameters, and the distance between eye-lense of the eye-piece and dry plate was a trifle greater than the distance between the eye-lens and the object. Although the room, Prof. Thomas's laboratory in the Ohio State University, was crowded with perhaps 100 people who moved about considerably, the negative made, though not exactly first-class, proved to be a good one when developed.—SECRETARY.